Independent claims 1 (device corresponding to the method recited by claim 29) and 29 (method corresponding to the device recited by claim 1) have been amended. Claims 2 and 30, depending therefrom, respectively, have been cancelled.

Attached herewith is a marked up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version with marks to show changes made".

Briefly, the present invention relates to a piezoelectric device featuring a first element of porous silicon, a second element attached to, or integrally formed with, the first element, and at least one electrode in electrical contact solely with the first element of the first and second elements, such that subjecting the first element to an electric potential via the at least one electrode results in a strain induced by the first element on the second element.

A corresponding method of inducing a strain by a first element of porous silicon on a second element, features the steps of attaching to, or integrally forming with, the first element, the second element, and having at least one electrode be in electrical contact solely with the first element of the first and second elements, such that subjecting the first element to an electric potential via the at least one electrode results in a strain induced by the first element on the second element.

'Obvious-to-correct' Corrections

By this Amendment, the Applicant has corrected 'obvious-to-correct' component reference number errors appearing in the text of the specification, on p. 42, in line 16 and in line 19, of ***EXAMPLE 3***, and, appearing in corresponding Figure 2, as follows:

On page 42, line 16, 'obviously incorrect' originally written reference number **34** in the phrase "collimating lens **34**" has been replaced by the correct reference number **36**.

On page 42, line 19, 'obviously incorrect' originally written reference number **34** in the phrase "back through lens **34**" has been replaced by the correct reference number **36**, and, 'obviously incorrect' originally written reference number **36** in the phrase "focusing lens **36**" has been replaced by the correct reference number **24**.

Accordingly, the paragraph beginning at page 42, line 12, has been replaced with an appropriately rewritten paragraph, including these corrections, as indicated herein above and below.

In Fig. 2, corresponding to immediately preceding amended text in the specification, 'obviously incorrect' second appearance of reference number **34**, pointing to the (bottom part of) vertically positioned oval or convex lens on the right side of optical system **20** illustrated in Fig. 2, has been replaced by correct reference number **36**, as clearly indicated by the 'red' correction markings made on the herein enclosed copy of Fig. 2 as originally filed.

Correction of the above described 'obvious-to-correct' errors is respectfully requested.

35 U.S.C. 102(e) Rejection - Takeuchi

The Examiner has rejected claim 1 under 35 U.S.C. 102(e) as being anticipated by Takeuchi. The Examiner's rejection is respectfully traversed. Claim 1 has now been amended.

While continuing to traverse the Examiner's rejection, Applicant has chosen to amend claim 1, to include the limitations of now canceled claim 2, thereby rendering moot the Examiner's rejection.

35 U.S.C. 103(a) Rejection

The Examiner has rejected claim 2 under 35 U.S.C. 103(a) as being unpatentable over Takeuchi in view of Seefeldt. The Examiner's rejection is respectfully traversed. Claim 2 has

now been canceled. Claim 1 has now been amended to include the limitations of now canceled claim 2.

In said Office Action, the Examiner stated that "Seefeldt discloses for the purpose of accurately measuring low force changes, a piezoelectric device comprising a first silicon porous material 138, a second element made of crystal 62 attached to first element, and at least one electrode 114 being in electrical contact with first element (see figure 25), such that subjecting first element to an electric potential results in strain induced by first element on second element (column 4, lines 54-58 and column 5, lines 53, 62, 63 and column 6, lines 3-7)".

Additionally, in said Office Action, the Examiner stated that "It would have been obvious to one having ordinary skill in the art at the time the invention was made to design a piezoelectric device as disclosed by Takeuchi et al. and to modify the invention by using certain material for the first element for the purpose of accurately measuring low force changes as disclosed by Seefeldt".

The Applicant of the present invention strongly contends that the Examiner is clearly incorrect by using the Seefeldt disclosure for 'attempting' to show unpatentability, based on obviousness, of the piezoelectric device of the present invention as recited by amended claim 1. In particular, the Applicant strongly contends that it certainly would not have been obvious, and that there would have been absolutely no motivation to one having skills in the art to use the sacrificial 'intermediate' or 'precursor' layer of "porous silicon" disclosed by Seefeldt for forming a force transducer, because, until the findings that led to the development of the present invention were uncovered, no artisan knew that porous silicon has piezoelectric characteristics.

In the disclosure of Seefeldt, with reference to the figures indicated therein, in column 4, lines 54 - 58, as cited by the Examiner, it is stated ". . . end portions 70 allows strain in the

epitaxial layer 60 (or in the substrate 14) in the direction of the longitudinal axis 66 of the beam 62 to change the resonant frequency of the beam 62. In the specific embodiment illustrated, the beam 62 is part of the epitaxial layer 60 . . . "; in column 5, lines 62 - 63, as cited by the Examiner, it is stated "The transducer 10 includes means for measuring resonating motion of the beam 62"; and, in column 6, lines 3 - 7, as cited by the Examiner, it is stated "The resistance of the piezoresistor 122 changes with strain in the beam 62 in accordance with the piezoresistive effect, and thus permits resonance of the beam 62 to be measured in a known manner".

It ought to be absolutely clear to one of ordinary skill in the art, that by carefully reading and properly understanding the Seefeldt disclosure, that each of the preceding citations by the Examiner relates to describing operation of the 'completely' formed force transducer 10 only, as disclosed therein in relatively expansive illustrative detail. The force transducer 10 of Seefeldt is completely formed only after implementing a tedious multi step-by-step procedure, as disclosed therein, involving a long series of multiple steps and sub-steps following the steps of physicochemically converting and removing the porous silicon layer from the precursor structure of the force transducer.

Equally stated, the cited Seefeldt invention involves porous silicon 'exclusively' during intermediate processing steps used 'only' for producing intermediate precursor structures during the forming of the force transducer 10. The produced force transducer 10 device clearly and definitely has no porous silicon in its structure, and therefore, there is no 'obviously' derived role or function of porous silicon during operation of the force transducer involving inducing strain for causing change in the resonant frequency of the beam 62.

Support for this contention by the Applicant is clearly found throughout the entire Seefeldt disclosure, especially with reference to description relating to formation of the transducer 10, as indicated in column 6, lines 25 - 46. Therein, it is stated "5. forming porous

silicon of the p-type layer 138 and the p-type sinkers 142 by anodization; 6. oxidizing the porous silicon to form silicon dioxide in three pre-cavity regions;".

Additionally, in column 8, lines 31 - 33, wherein it is stated "The p-type layer 138 and the p-type sinkers 142 are anodized to form a pre-cavity region consisting of porous silicon". Additionally, in column 8, lines 47 - 51, wherein it is stated "The porous silicon thus defines a pre-cavity region in the area previously occupied by the p-type layer 138 and p-type sinkers 142. The porous silicon in the pre-cavity region is oxidized to form silicon dioxide". Additionally, in column 8, lines 60 - 64, wherein it is stated "Upon oxidation, the porous silicon in the pre-cavity region is converted to silicon dioxide, and a layer of silicon dioxide having a thickness of about 1500 angstroms is incidentally formed over the entire upper surface of the n-type epitaxial layer 60; and, in column 9, lines 55 - 57, wherein it is stated "The porous silicon dioxide in the pre-cavity regions is removed or dissolved by etching to form the cavities 22, 46 and 50".

During this stage of the disclosed procedure for forming the transducer 10, the intermediate porous silicon layer is chemically converted to another form, that is, to an intermediate porous silicon dioxide layer, and is therefore no longer present during the many subsequent steps and sub-steps for forming the transducer 10, and, thus, the porous silicon layer is not present during operation of the force transducer 10.

Moreover, throughout the entire disclosure of Seefeldt, there is no direct or indirect description, suggestion, or, hint, and, therefore, there is no motivation by one of ordinary skill in the art, of using the "porous silicon" disclosed by Seefeldt, other than as an intermediate or precursor layer or structure, needed for forming the pre-cavity and subsequent cavity regions, en route for producing the forced transducer 10 in a ready and operational form.

Indeed, with regard to using porous silicon as part of an intermediate or precursor layer or structure, porous silicon is formed in many micromachining processes as a sacrificial layer

of precursor structures of electronic devices, ordinarily used to produce an empty volume in a later or subsequent step for forming a finished structure or device, such as the previously cited pre-cavity regions in the intermediate precursor structures of the force transducer described in the Seefeldt disclosure, as well as intermediate precursor structures described in the other prior art previously cited by the Examiner, for example, in Iwata et al. (U.S. Patent No. 5,665,250), Yagi et al. (U.S. Patent No. 6,143,190), and, Seefeldt et al. (U.S. Patent No. 5,834,333), and, taught about in the Applicant's cited prior art, for example, as referenced on p. 33, in particular, and, throughout the Field and Background section, in the specification of the present invention.

Thus, by respectfully reiterating to the Examiner, the Applicant strongly contends that it certainly would not have been obvious, and that there would have been absolutely no motivation to one having skills in the art to use the sacrificial 'intermediate' or 'precursor' layer of "porous silicon" disclosed by Seefeldt for forming a force transducer, because, until the findings that led to the development of the present invention were uncovered, no artisan knew that porous silicon has piezoelectric characteristics.

The Applicant submits, therefore, that the preceding remarks and argument completely overcome the Examiner's rejection to claim 2 based on grounds of 35 U.S.C. 103(a).

In view of the above Applicant's amendment of claim 1, for overcoming the Examiner's 35 U.S.C. 102(e) rejection of claim 1, and, in view of the preceding Applicant's argument for overcoming the Examiner's 35 U.S.C. 103(a) rejection of claim 2, the Applicant submits that amended claim 1, including limitation of now cancelled claim 2, is in condition for allowance, and such action is respectfully and earnestly solicited.

In view of the preceding discussion, the Applicant submits that claim 3, depending from allowable amended independent claim 1, is allowable in its present form and such action is respectfully requested.

Objection

The Examiner has objected to the drawings under 37 CFR 1.83(a). Specifically, the Examiner stated that the "isolating channels such as spaces" disclosed in claim 2 must be shown or the feature(s) cancelled from the claim(s).

By this Response, the Applicant has cancelled claim 2. Additionally, as apparent from above Applicant's amendment of claim 1, by including limitation of now cancelled claim 2, excluding recitation of the feature of "isolating channels such as spaces", for overcoming the Examiner's 35 U.S.C. 102(e) rejection of claim 1, this feature is thereby excluded and cancelled from the claims.

In view of the preceding remarks, the Applicant submits that Examiner's objection to the drawings under 37 CFR 1.83(a) is completely overcome.

The Examiner has withdrawn claims 29 - 31 from consideration as being directed to a non-elected invention, according to 37 CFR 1.142(b) and MPEP 821.03. Specifically, the Examiner stated that "Claims 29 - 31 disclose piezoelectrically inducing an object, which is not required by the disclosure of claims 1 - 3".

During said telephone interview, the Applicant explained to the Examiner that the intention of claims 29 - 31 was to read upon the method, fully supported by the originally filed specification, corresponding to recitations of claims 1 - 3 reading upon the device of the present invention. In view of this explanation, the Examiner agreed to the Applicant's request to amend claims 29 - 31 reading upon the method, in a way appropriately consistent and complementary to amendment of claims 1 - 3 reading upon the device, of the present invention.

Thus, in view of the above Applicant's amendment to claim 1, the Applicant has amended claim 29, by including limitation of now cancelled claim 30, using language appropriately consistent and complementary to that used in amended claim 1.

In view of the preceding remarks and amendment, the Applicant submits that amended claim 29 is in condition for allowance, and such action is respectfully and earnestly solicited.

In view of the preceding discussion, the Applicant submits that claim 31, depending from allowable amended independent claim 29, is allowable in its present form and such action is respectfully requested.

Culp (U.S. Patent No. 5,262,696), Bernstein (U.S. Patent No. 6,222,304), and, Andrews (U.S. Patent No. 4,517,486), cited by the Examiner in PTO-892, have been carefully reviewed, but are deemed not to render the Applicant's invention unpatentable, either singly or in combination, as was properly determined by the Examiner in said Office Action.

By this Response, the Applicant respectfully submits that independent claims 1 and 29, and hence dependent claims 3 and 31, respectively, are now in condition for allowance, and such action is respectfully and earnestly solicited.

The Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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Attorney for Applicant
Registration No. 25,457

Date: May 12, 2002

Encl.:
1. VERSION WITH MARKINGS TO SHOW CHANGES MADE.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Text in bold brackets, **[** xxxx **]**, means that the bracketed letter, word, phrase, or section, has been 'deleted' / 'cancelled' from the indicated original Specification / claim, and 'does not' appear in the indicated replacement (amended) Specification / claim. Underlined text, xxxx, means that the letter, word, phrase, or section, has been 'added' to the indicated original Specification / claim, and 'does' appear in the indicated replacement (amended) Specification / claim.

In the Specification:

The paragraph beginning at line 12 of page 42 has been amended as follows:

Referring now to Figure 2, a simple optical system **20** was constructed that allows one to re-image different planes on a camera **22**. System **20** includes a point source **30** and a lens **32** so as to focus light just before a surface of a mirror **34**. Mirror **34** is so positioned so as to reflect the light through a collimating lens **[34]** **36** onto a sample **26**, which is a mirror in accordance with the teachings of the present invention made and constructed as described hereinabove, and from which the light is reflected back through lens **[34]** **36** to a motorized (**M**) focusing lens **[36]** **24** which focuses the light onto a CCD camera **22**. By moving lens **24** in front of camera **22**, one can choose two planes to overlap (before and after reflection from sample **26**), or at any two other locations using a frame grabber **40** and an appropriate computer **42** and software.

In the Claims:

Claims 1 and 29 have now been amended as follows:

1. (Amended) A piezoelectric device comprising a first element of porous crystalline [material] silicon , a second element being attached to, or integrally formed with, said first element, and at least one electrode being in electrical contact solely with said first element of said first and second elements, such that subjecting said first element to an electric potential via said at least one electrode results in a strain induced by said first element on said second element.

29. (Amended) A method of [piezoelectrically] inducing a strain [in an] by a first element of porous crystalline silicon on a second element, the method comprising the steps of attaching to [the element], or integrally forming with, the first element, [an additional] the second element, [of porous crystalline material being in electrical contact solely with] and having at least one electrode being in electrical contact solely with the first element of the first and second elements , such that subjecting [said additional] the first element to an electric potential via said at least one electrode results in a strain induced by [said additional] the first element on the second element.